CLAIMS

We claim:

1. A sensor for imaging chemical and/or biological samples contained in or containing fluids, which comprises:

an array of impedance electrode elements;

a fluid-impervious layer separating said elements from said samples so as to prevent electrode fouling and having an inner surface facing said elements and an outer surface on which said samples are placed; and

means for applying electrical interrogating signals to said elements, measuring impedance signals which are generated by said interrogating signals, and converting the resulting signals into visual images.

2. The sensor of claim 1, wherein said array is comprised of many tiny capacitive electrode pairs, each pair disposed as a tiny two-dimensional pixel, so as to form a two-dimensional imaging lattice.

3. The sensor of claim 2, wherein said fluid-impervious layer comprises phosphosilicate glass, silicon nitride, silicon carbide, or a polymeric material, such as polyethylene, polypropylene, polytetrafluoroethylene, polymethacrylate or polycarbonate.

4. The sensor of claim 2, wherein a test sample can come in contact only with glass or derivatized glass, which causes no contamination of the sample, and whose effect on the sample is minimal.

5. The sensor of claim 1, wherein said outer surface is amenable to the chemical attachment of active elements that can interact with chemical or biological molecules and/or particles.

6. The sensor of claim 5, wherein said surface is treated so as to effectuate selective binding to said surface of specific molecular species or of specific biological particles.

7. The sensor of claim 6, wherein said treated surface permits antibody binding to be observed as it occurs.

8. The sensor of claim 2, wherein said two-dimensional pixels are small enough to permit detection and imaging of single cells, bioparticles, DNA fragments, and molecular specific events.

9. The sensor of claim 1, wherein said signals converting means is capable of acquiring two or more channels of information at one time.

10. The sensor of claim 1, wherein said signals converting means is capable of following changes in said samples so as to perform biochemical or biological imaging in vivo on living tissue or on living cells.

11. The sensor of claim 1, wherein said electrical interrogating, signals measuring, and signals converting means utilizes a selected alternating frequency for the interrogating signals and is able to interpret impedance changes in terms of molecular or cellular parameters.

12. The sensor of claim 1, wherein said signals converting means is able to effectuate quantitative measurements of ions in immediate proximity to cell membranes.

13. The sensor of claim 10, wherein said signals converting means comprises means for monitoring metabolic changes in real time or the progress of cryosurgery.

14. The sensor of claim 1, wherein said signals converting means comprises means for diagnosing any occurrence of cancer or of bacterial contamination by comparing observed images with a library of cancerous cell shapes or of pathogen cell shapes.

15. A method of imaging chemical and/or biochemical samples which comprises the steps of:

placing said samples adjacent to a fluid-impervious layer which separates them from an array of capacitive electrode elements;

applying electrical interrogating signals to said elements;

measuring impedance signals which are generated by said interrogating signals; and

converting the resulting signals into visual images.

16. The method of claim 15, comprising a preliminary step of pre-treating the surface of said layer so as to effectuate selective binding to said surface of specific molecular species or of specific biological particles.

17. The method of claim 16, comprising the further step of interpreting said impedance signals so as to observe molecular or cellular parameters, such as the toxins, cell lines, bio-fouling or bio-materials buildup, viability or metabolic changes.

18. The method of claim 16, wherein said pre-treating step comprises derivatizing said surface to isolate specific molecular species.

19. The method of claim 18, wherein said pre-treating step comprises coating said surface with a reactive compound to enable selective gas or vapor sensing.

20. The method of claim 16, wherein said pre-treating step comprises selective

derivatization of said surface allowing only selected biological particles, such as cells, spores, pollen grains or other specific cell lines, to attach thereto, and wherein said interpreting step comprises monitoring the size, shape, viability, type, or status of the attached biological particles.

21. The method of claim 20, wherein said pre-treating step comprises chemical derivatization of said surface and induction of selectivity by covalent binding of antibodies or oligonucleotides.

22. The method of claim 17, wherein said interpreting step comprises monitoring metabolic changes in real time or the progress of cryosurgery.

23. The method of claim 17, wherein said interpreting step comprises comparing observed images with a library of cancer cell shapes so as to diagnose any occurrence of cancer.

24. The method of claim 17, wherein said interpreting step comprises comparing observed images with a library of pathogen cell shapes so as to diagnose any occurrence of bacterial contamination.

25. The method of claim 21 which comprises generating two or more derivatized surface patterns, each pattern corresponding to a different analyte, and programming the sequence of interrogating signals so as to generate a separate image of each of said patterns.

26. The method of claim 19, wherein said gas or vapor is or originates from a hazardous or illicit substance, such as a chemical warfare agent, a carcinogenic or otherwise toxic industrial emissions product, an explosive compound, or a narcotic.

27. The sensor of claim 12, wherein said signals converting means is able to effectuate selective detection and measurements of specific molecular species.

28. The sensor of claim 27, wherein said species is absorbed or adsorbed from a gaseous phase.

29. The sensor of claim 28, wherein said species is or originates from a hazardous or illicit substance, such as a chemical warfare agent, a carcinogenic or otherwise toxic industrial emissions product, an explosive compound, or a narcotic.